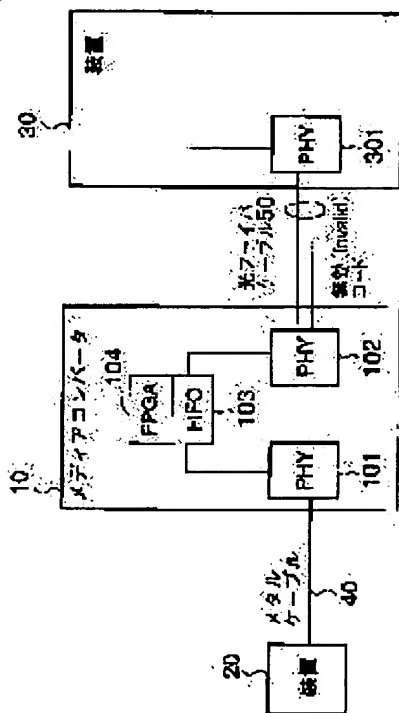


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(54) MEDIA CONVERTER AND ITS LINK DISCONNECTING METHOD



(57)Abstract:

PROBLEM TO BE SOLVED: To provide a link disconnecting method for reliably disconnecting a link even in communication equipment which does not correspond to a remote fault function and also to provide a media converter.

SOLUTION: First and second communication units (20) and (30) based on the standard of 'Ethernet(R)' of gigabit class are connected to the media converter (10) respectively with a metal cable (40) and an optical fiber cable (50). The media converter monitors whether the link at the side of the metal cable is disconnected or not. When the link is disconnected at the side of the metal cable, a desired ineffective code other than the code which is previously defined by the standard complied by the second communication equipment is continuously transmitted to the second communication equipment via the optical fiber cable so that the link is disconnected at the

side of the second communication equipment.

[Brief Description of the Drawings]

[Drawing 1] It is a block diagram showing one embodiment of the Gigabit Ethernet using the media converter by this invention.

[Drawing 2] (A) is a flow chart which shows the outline of the program included in FPGA in one embodiment of the media converter by this invention, and (B) is a mimetic diagram showing an example of 8B / 10B code translation table used by this embodiment.

[Drawing 3] It is a block diagram showing the functional constitution of the usual physical layer device.

[Description of Notations]

10 Media converter
20 Communication apparatus
30 Communication apparatus
40 Metal cable
50 Fiber optic cable
101 Physical layer device
102 Physical layer device
103 FIFO memory
104 FPGA
301 Physical layer device (PHY)
302 Physical Medium Dependent part (PMD)
303 Physical-media terminal area (PMA)
304 Physical coding sublayer (PCS)
305 GMII

[Detailed Description of the Invention]

[0001]

[Field of the Invention] this invention relates to the Ethernet (a registered trademark and the following -- the same) of a gigabit class, and relates to a media converter especially connected to such a network, and the unlinking method for the same.

[0002]

[Description of the Prior Art] When a Local Area Network (LAN) connects by network two or more computers, a server, a printer, etc., it is an indispensable network. Especially Ethernet system LAN art is that standardization of 1000BASE-X (IEEE802.3z) and 1000BASE-T (IEEE802.3ab) was completed recently, and is becoming the leading role of the high-speed multimedia network age.

[0003] Such LAN can lengthen a communication range by using an optical fiber. That is, a communication range is extensible by forming a media converter in the both ends of the link between adjoining nodes, respectively, and relaying a metal cable with a fiber optic cable.

[0004] A fiber-optics circuit is extended to each home, and FTTH (Fiber To The Home) which can exchange music, video, medical data, etc. free by a high speed line is attracting attention in recent years. When the FTTH age comes, the media converter which connects a fiber-optics circuit to the metal cable of an office or a domestic computer is needed. Thus, a media converter is communication equipment indispensable to a future high-speed multimedia network.

[0005] The port and UTP (Unshielded Twisted Pair) for generally connecting an optical cable to a media converter. The physical layer device is formed in each of the port for connecting a cable.

Each physical layer device is supporting MII (Media Independent Interface) specified by IEEE802.3 standard.

[0006] The device which a UTP cable and the fiber optic cable need to have one cable including a media converter regarded, and is connected is installed in the mutually distant place on the character of such a media converter in many cases. For this reason, as for while, when a link is cut, what has the missing link function to cut the link of another side automatically is common. For example, when power OFF of the device by the side of a UTP cable was carried out, or a certain obstacle occurs and is cut, the link by the side of a fiber optic cable also cuts a media converter automatically.

[0007] In the standard of the Gigabit Ethernet which uses an optical fiber, an unlinking demand can be performed to the device connected by the optical fiber using the remote fault (Remote Fault) function. A remote fault signal is stored in the configuration (Configuration) packet in the auto negotiation which will be the requisite by Gigabit Ethernet, and is transmitted to the partner point.

[0008]

[Problem(s) to be Solved by the Invention] However, there are some problems in the unlinking method using a remote fault function.

[0009] Since a remote fault signal is included in the configuration packet in an auto negotiation as mentioned above to the 1st, the remote fault function operates only between the devices corresponding to an auto negotiation. Naturally, it does not operate in manual (Manual) mode, either.

[0010] In the 2nd, how a remote fault function is interpreted may differ between communication apparatus, and an unlinking demand may not be correctly interpreted. For example, the device interpreted as it not being what means unlinking that a remote fault signal is receivable since I hear that it is connected normally and there is between devices also exists. For this reason, unlinking may not be carried out even if a remote fault function tries to perform unlinking.

[0011] Although it is a problem transitional to the 3rd, since the standard of Gigabit Ethernet itself is still new, that in which the remote fault function is not mounted exists in the device of a part of first stages. In the network in which the device which is not such mounted is intermingled, a link cannot be certainly cut using a remote fault function.

[0012] Even if the purpose of this invention is the communication equipment corresponding to [un-] a remote fault function, there is in providing the media converter which has the unlinking method and such an unlinking function in which unlinking can be performed certainly.

[0013]

[Means for Solving the Problem] Communication by an optical fiber of Gigabit Ethernet is performed using conversion (8B / 10B code translation) with the 8-bit (8B) data of GMII (Gigabit Media Independent Interface), and a 10-bit (10B) code. Since it has one 4 times the code capacity of this because bit width increased by 2 bits, a code which is not assigned exists. Generally a code unassigned [these] is treated as an invalidity (Invalid) code, and it becomes impossible for a device which received an invalid code continuously to maintain a link condition (see the 36.2.5.2.6 paragraph of an IEEE802.3z standard).

[0014] Using this character, even if this invention is a device which is not corresponded to a remote fault function, it performs unlinking certainly, and it realizes a missing link of a media converter.

[0015] In a method of cutting a link between two communication apparatus which according to the 1st viewpoint of this invention were connected with a fiber optic cable and based on an Ethernet standard of a gigabit class, When cutting said link, an invalid code of a request of those other than a code beforehand defined by said standard is continuously transmitted to a communication apparatus of another side through said fiber optic cable from one communication apparatus, A communication apparatus of said another side which received said invalid code continuously cuts said link.

[0016] In an unlinking method of a media converter which was connected with the 1st communication apparatus and the 2nd communication apparatus based on a standard of Ethernet of a gigabit class by a metal cable and fiber optic cable, respectively according to the 2nd viewpoint of this invention, When it supervised whether a link by the side of a metal cable cut and a link by the side of a metal cable cuts, A link by the side of said 2nd communication apparatus is cut by transmitting continuously an invalid code of a request of those other than a code beforehand defined by a standard on which said 2nd communication apparatus is based to said 2nd communication apparatus through said fiber optic cable.

[0017] Especially a standard on which the 2nd communication apparatus is based is 1000BASE-X of an IEEE802.3z standard, and ten bit codes and invalid codes by which a code beforehand defined by said standard was defined by 8B / 10B code translation table are the other ten bit codes. As for all invalid codes, it is desirable that they are codes other than 0 or a code altogether set to 1.

[0018] In a media converter which is connected with the 1st communication apparatus and the 2nd communication apparatus based on a standard of Ethernet of a gigabit class by a metal cable and fiber optic cable, respectively according to the 3rd viewpoint of this invention, The 1st physical layer interfacing means which connects said metal cable, and the 2nd physical layer interfacing means which connects said fiber optic cable, A memory means for storing temporarily data which is connected between said 1st and 2nd physical layer interfacing means, and is transmitted among them, It is supervised whether a link by the side of a metal cable cut through said 1st physical layer interfacing means,

By a standard on which said 2nd communication apparatus is based when a link by the side of said metal cable cuts. It has a control means which cuts a link by the side of said 2nd communication apparatus by transmitting continuously an invalid code of a request of those other than a code defined beforehand to said 2nd communication apparatus through said 2nd physical layer interfacing means.

[0019]

[Embodiment of the Invention] Drawing 1 is a block diagram showing one embodiment of the Gigabit Ethernet using the media converter by this invention. Here, in order to explain simply, it consists of the gigabit media converter 10 and the communication apparatus 20 and 30. The network with which the media converter 10 is connected to the device 20 by the metal cables 40, such as a UTP cable, and is connected to the device 30 by the fiber optic cable 50, respectively is illustrated. The switch of LAN, a node, or a media converter may be sufficient as the communication apparatus 20 and 30, for example.

[0020] In drawing 1, the physical layer devices (PHY) 101 and 102 are formed in the port of the couple of the media converter 10, respectively, one physical layer device 101 is connected to the metal cable 40, and the physical layer device 102 of another side is connected to the fiber optic cable 50, respectively. Each of the physical layer devices 101 and 102 in this embodiment supports GMII (Gigabit Media Independent Interface) specified by IEEE802.3z.

[0021] Between the physical layer device 101 and the physical layer device 102, The chip which consists of the FIFO (First in First out) memory 103 and FPGA(Field Programmable Gate Array) 104 is formed, and the frequency deviation during transmission and reception can be absorbed by FIFO memory 103. The data received with one physical layer device is written in FIFO memory 103 one by one, is read to the written-in order, and is sent out to the physical layer device of another side. The invalid-code transmission procedure is built into FPGA104 so that it may mention later.

[0022] According to this embodiment, if a missing link is started, the media converter 10 sends out continuously the invalid code mentioned later to the device 30. It becomes impossible for the physical layer device 301 of the device 30 to maintain a link condition, and unlinking of the fiber optic cable 50 is realized by this. Hereafter, operation of the media converter 10 in this embodiment is explained.

[0023] (Missing link operation of a media converter) Drawing 2 (A) is a flow chart which shows the outline of the program included in FPGA in one embodiment of the media converter by this invention, (B) is a mimetic diagram showing an example of 8B / 10B code translation table used by this embodiment.

[0024] If the link-off (link#off) by the side of a metal cable is detected by the physical layer device 101 (Step S401), FPGA104 starts the missing link by the side of the fiber optic cable 50 with the physical layer device 102, and is a 10-bit invalid code (here). '1100000011' is continuously sent out to the device 30 through the fiber optic cable 50

from the physical layer device 102 (Step S402).

[0025] (Invalid code) 8B / 10B code translation performed by the physical coding sublayer (PCS:Physical Coding Sublayer) of the physical layer device 102 are performed using the code translation table (datacode and special code) shown in drawing 2 (B).

[0026] In order that bit width may increase from 8 bits to 10 bits by 8B / 10B code translation, codes other than data can be defined. Although some are assigned as a special code among these codes, the code which is not assigned to datacode and a special code exists. The code which is not such assigned is treated as an invalidity (Invalid) code, and it becomes impossible for the physical layer device which received the invalid code continuously to maintain a link condition (see the 36.2.5.2.6 paragraph of an IEEE802.3z standard).

[0027] Although the invalid code in particular to be used is not limited, since DC balance of a receiver may be put out of order, the invalid code that all the bits are set to 0 or 1 should be avoided. According to this embodiment, '1100000011' was used as an invalid code.

[0028] (Operation of an invalid-code receiver) Drawing 3 is a block diagram showing the functional constitution of the usual physical layer device. Here, the functional constitution of the physical layer device 301 of the device 30 shown in drawing 1 is shown. The lightwave signal received through the fiber optic cable 50 is changed into electric serial data by the Physical Medium Dependent part (PMD:Physical MediumDependent) 302, Clock reproduction and 10 bit-parallel conversion are performed by the physical-media terminal area (PMA:Physical Medium Attachment) 303. 8B10B decoding of these 10-bit parallel data is carried out by PCS304, and the 8-bit received data and control data which were obtained are outputted to GMII305.

[0029] Although carried out using the code translation table (datacode and special code) it is indicated to drawing 2 (B) that mentioned above 8B10B decoding of PCS304, when the above-mentioned invalid code is received continuously, it becomes impossible to maintain a synchronization and a link is cut compulsorily. In other words, even if the physical layer device 301 has not corresponded to a remote fault function, unlinking is performed only by receiving an invalid code continuously from the fiber optic cable 50 side. Thus, it is very effective to use an invalid code for unlinking in an optical fiber.

[0030]

[Effect of the Invention] As explained to details above, unlinking is realizable by transmitting a substandard invalid code continuously to the communication apparatus which uses the optical fiber of Gigabit Ethernet. By using this character, even if it is a device which is not corresponded to a remote fault function, unlinking is performed certainly, and it becomes possible to realize the missing link in the optical fiber of a media converter.

[Claim(s)]

[Claim 1] In a method of cutting a link between two communication apparatus which were connected with a fiber optic cable and based on an Ethernet (registered trademark) standard of a gigabit class, When cutting said link, an invalid code of a request of those other than a code beforehand defined by said standard is continuously transmitted to a communication apparatus of another side through said fiber optic cable from one communication apparatus, An unlinking method that a communication apparatus of said another side which received said invalid code continuously is characterized by what said link is cut for.

[Claim 2] In an unlinking method of a media converter connected with the 1st communication apparatus and the 2nd communication apparatus based on a standard of Ethernet of a gigabit class by a metal cable and fiber optic cable, respectively, When it supervised whether a link by the side of a metal cable cut and a link by the side of a metal cable cuts, An unlinking method of a media converter characterized by what a link by the side of said 2nd communication apparatus is cut for by transmitting continuously an invalid code of a request of those other than a code beforehand defined by a standard on which said 2nd communication apparatus is based to said 2nd communication apparatus through said fiber optic cable.

[Claim 3] An unlinking method according to claim 2, wherein a standard on which said 2nd communication apparatus is based is 1000BASE-X of an IEEE802.3z standard.

[Claim 4] An unlinking method according to claim 3, wherein codes beforehand defined by said standard are ten bit codes defined by 8B / 10B code translation table and said invalid codes are the other ten bit codes.

[Claim 5] An unlinking method according to any one of claims 2 to 4, wherein said all invalid codes are codes other than 0 or a code altogether set to 1.

[Claim 6] A media converter connected with the 1st communication apparatus and the 2nd communication apparatus based on a standard of Ethernet of a gigabit class by a metal cable and fiber optic cable, respectively, comprising:

The 1st physical layer interfacing means which connects said metal cable.

The 2nd physical layer interfacing means which connects said fiber optic cable.

A memory means for storing temporarily data which is connected between said 1st and 2nd physical layer interfacing means, and is transmitted among them.

It is supervised whether a link by the side of a metal cable cut through said 1st physical layer interfacing means, A control means which cuts a link by the side of said 2nd communication apparatus by transmitting continuously an invalid code of a request of those other than a code beforehand defined by a standard on which said 2nd communication apparatus is based when a link by the side of said metal cable cuts to said 2nd communication apparatus through said 2nd physical layer interfacing means.

[Claim 7] The media converter according to claim 6, wherein said 1st and 2nd physical

layer interfacing means supports GMII (Gigabit Media Independent Interface) specified by IEEE802.3z standard, respectively.

[Claim 8] The media converter according to claim 6, wherein said control means is FPGA (Field Programmable Gate Array).

[Claim 9] The media converter according to claim 6, wherein a standard on which said 2nd communication apparatus is based is 1000BASE-X of an IEEE802.3z standard.

[Claim 10] The media converter according to claim 9, wherein codes beforehand defined by said standard are ten bit codes defined by 8B / 10B code translation table and said invalid codes are the other ten bit codes.

[Claim 11] A system which has the media converter connected with the 1st communication apparatus and the 2nd communication apparatus based on a standard of Ethernet of a gigabit class by a metal cable and fiber optic cable, respectively, comprising:

The 1st physical layer interfacing means to which said media converter connects said metal cable.

The 2nd physical layer interfacing means which connects said fiber optic cable.

A memory means for storing temporarily data which is connected between said 1st and 2nd physical layer interfacing means, and is transmitted among them.

It is supervised whether a link by the side of a metal cable cut through said 1st physical layer interfacing means, When a link by the side of said metal cable cuts, have a control means which transmits continuously an invalid code of a request of those other than a code beforehand defined by a standard on which said 2nd communication apparatus is based to said 2nd communication apparatus through said 2nd physical layer interfacing means, and said 2nd communication apparatus, The 3rd physical layer interfacing means which cuts a link when said fiber optic cable is connected and said invalid code is received continuously.

[Claim 12] An unlinking control program built into a media converter connected with the 1st communication apparatus and the 2nd communication apparatus based on a standard of Ethernet of a gigabit class by a metal cable and fiber optic cable, respectively, comprising:

A step which supervises whether a link by the side of a metal cable cut.

A step from which a link by the side of said 2nd communication apparatus is cut by transmitting continuously an invalid code of a request of those other than a code beforehand defined by a standard on which said 2nd communication apparatus is based to said 2nd communication apparatus through said fiber optic cable when a link by the side of a metal cable cuts.

[Claim 13] A programmable integrated circuit which stored the unlinking control program according to claim 12.

FIG.1

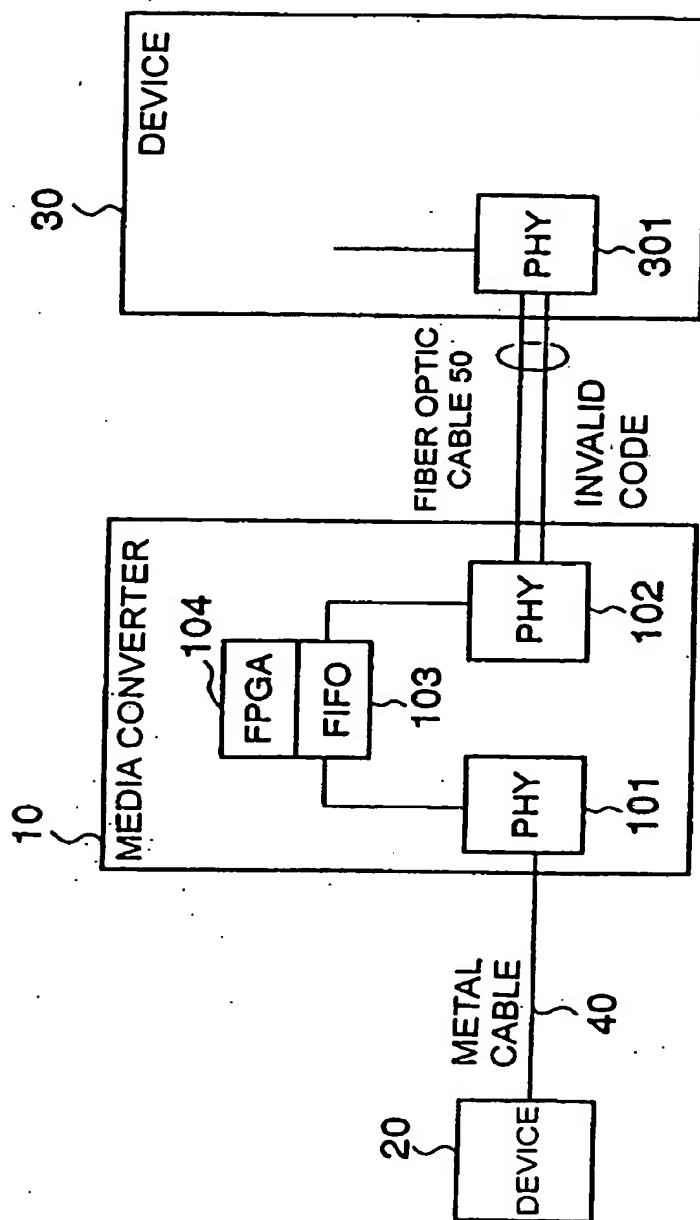


FIG.2 (A)

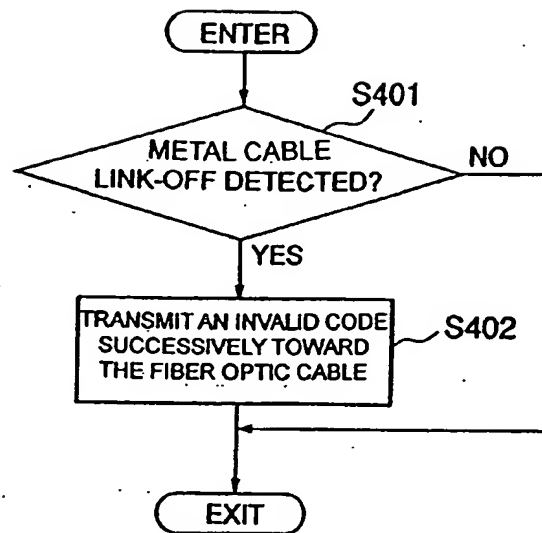


FIG.2 (B)

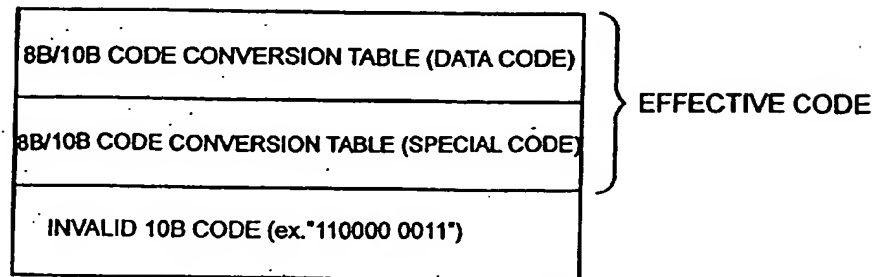


FIG.3

